European Lighting Companies Federation

Radioactive Substances in Lighting Products

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1. Introduction

The lighting industry manufactures products, which may partly contain small amounts of radioactive substances. The application of radioactive substances in so called “consumer products” is restricted by severe legal regulations with regard to safety of the consumer.

The intention of this information sheet is to inform interested parties about the application of radioactive isotopes in lamp technique and the resulting limited radiation exposure.

2. Application of Radioactive Substances

There are generally three reasons for the application of radioactive substances in lighting products:

a) Ionisation of the filling gas inside the product in order to generate free electrons for starting the ignition and enhancing the discharge.
b) Decreasing of the electron workfunction at the top of the tungsten-cathode for better emission.
c) Improvement of the metallurgical properties of the tungsten-electrodes (especially by Th, which is resistant also at very high temperatures).

These applications are only relevent to discharge lamps and starters for fluorescent lamps (function of glow switch). The following table shows the four applied isotopes in lamp technology. The most important of these are the rare noble gas Kr-85 and the natural occurring Th-232.

Isotope	***Chemical symbol***	***Physical form***	***Radiation***	***Component***
Tritium	H-3	Solid (bounded)	Beta	Inner surface
Krypton-85	Kr-85	Gaseous	Beta, Gamma	Filling gas
Promethium-147	Pm-147	Solid	Beta	Wire or pellet
Natural Thorium	Th-232	Solid	Alpha (Beta, Gamma)	Electrodes

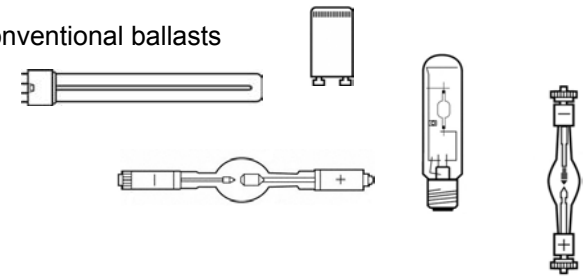
These isotopes have been selected because they have a sufficient half-life and a suitable type of radiation with good ability to ionise. They emit alpha and beta -radiation with high ionisation inside the product, and without penetrating the bulb. The share of gamma-radiation, which may be able to penetrate the bulb, is neglectable; therefore the radiation exposure to the consumer is very small (see paragraph 4). The applied activity inside the lighting products ranges between a few and several thousand *becquerels* (unit of activity: 1 Bq is 1 decay per second).

Many lamp manufacturers have enhanced their research and development for the reduction and in some cases elimination of the radioactive substances in their products, and have already made enormous progress. Many current applications however, do not work without the required radionuclides.

Products

The following lighting products can contain radioactive substances:

- Starters for fluorescent lamps:
- Compact fluorescent lamps: with integrated starter for conventional ballasts
- Metal-halide-lamps
- Xenon - short arc lamps
- Mercury - short arc lamps
- Some types of lamps for special use



3. Regulations and Requirements

The addition of radioactive substances in lighting products generally requires an approval of the EU Member State authority. The legal conditions for getting an approval are as follows:

a) Justification: Radioactive substances may only be used, if the resulting benefit is higher than the possible harm for health of man or the environment.
b) Optimisation: Addition of radionuclides must not be higher than necessary. (ALARA = as low as reasonably achievable)
c) Limitation: The added activity and the resulting radiation exposure of the consumer must not exceed the limit (e.g. 10 µSv/a - concept).

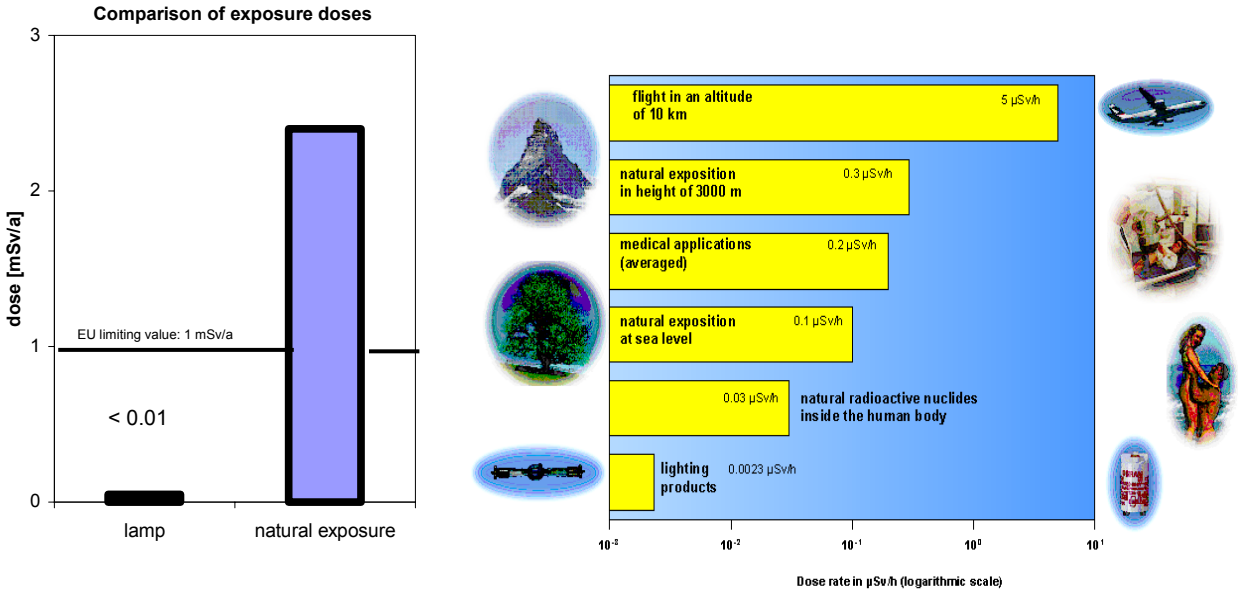
These conditions are based on a European Directive [1], which is valid in all member states of the EU and is adopted in national laws of the member states. The manufacturers of these products have to prove by sophisticated calculations [2] that the radiation exposure of the customer and consumer ranges maximal up to 10 micro Sievert per year by normal use, but also in case of accidents (breaking lamps) or by deposition. (*Unit of radiation dose: 1 milli Sievert = 1 mSv*)

4. Radiological Assessment

The radiation exposure of the consumer by lighting products ranges well below the natural background level (more than factor 100) [3]. The natural background radiation is caused by natural radionuclides in the earth, food and cosmic by-rays. Harm by radiation doses on the level of the natural background cannot really be proven.

Values for comparison:

- Limit of effective dose for single persons of the general population [1]: 1 mSv/a
- Natural radiation exposure: 1 -10 mSv/a (on average 2.4 mSv/a in Germany)



10 µSv/a corresponds to a dose rate of 0.0023 µSv/h. However, many influences on the human life cause much higher exposures (***e.g. a flight at an altitude of 10.000 m (33.000 ft) causes levels of exposure 2,000 times higher than that for lighting products***).

5. Rules for handling

For the handling and application of lighting products there are no special measures for necessary protection in the view of their radioactivity. The resulting radiation exposure by handling them is negligible and not considered to be dangerous. Lighting products are not regarded as “dangerous goods”.

6. Literature

[1] Council Directive 96/29 Euratom (1996)
[2] Council Directive 84/467 Euratom (1993)
[3] Report EC No. 4.1020/D/99-006 (2001): Transport of consumer goods containing small quantities of radioactive materials
Additional: Information sheets of the NRPB (National Radiological Protection Board, UK) (1994)

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